

EPA Region 5 Records Ctr.



356948

INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
STAGE 1
QUALITY ASSURANCE PROJECT PLAN
FOR
SCOTT AIR FORCE BASE

Environmental Resources Management

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REMEDIAL INVESTIGATION/
FEASIBILITY STUDY
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QUALITY ASSURANCE PROJECT PLAN
FOR
SCOTT AIR FORCE BASE

SEPTEMBER 1988

Prepared for:

United States Air Force
Headquarters Military Airlift Command
Command Civil Engineer (HOMAC/DEEV)
Scott AFB, Illinois
62225-5001

and

Occupational and Environmental Health Laboratory
Technical Services Division (OEHL/TS)
Brooks AFB, Texas 78235-5501

Prepared by:

Environmental Resources Management, Inc.
855 Springdale Drive
Exton, Pennsylvania 19341

Contract No. F33615-85-D-4515
ERM Project No. 44502-04-01



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OPPORTUNITY TO REVIEW

Date: 05 DEC 1988

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From: William D. Franz, Chief
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Bill Franz

The Environmental Review Branch has received the attached document for review. We are distributing the document for additional review with respect to the gathering and interpretation of data and possible environmental impacts with suggestions for mitigation. The comments will be incorporated in our letter of reply to the initiating Federal agency. Therefore, your prompt attention will be appreciated.

Document Name: *Installation Restoration Program - Remedial Investigation / Feasibility Study
Stage 1 Work Plan AND Quality Assurance Project Plan for
Scott Air Force Base, Illinois*

Due Dates:

Associate Review: *1-2-88* Principal Review (ERB): *1-6-88*

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QUALITY ASSURANCE PROJECT PLAN (QAPP)
FOR THE REMEDIAL INVESTIGATION
AT THE SCOTT AIR FORCE BASE, IL



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File No.: 445-02-04

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SECTION 1

QUALITY ASSURANCE/QUALITY CONTROL

1.1 INTRODUCTION

1.1.1 Air Force IRP Program

1.1.1.1 Program Origins

The Installation Restoration Program (IRP) is a Department of Defense (DOD) program for assessing and remediating hazardous waste problems on DOD installations. The IRP is designed to comply with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum, DEQPPM 81-5, which reissues, amplifies, and consolidates all previous directives and memoranda on the IRP. The IRP takes further program definition from the following Executive Orders (EO):

- EO 12088, which directs the DOD to comply with substantive and procedural statutes;
- EO 12316, which delegates responsibility for response actions at DOD sites to the Secretary of Defense; and
- EO 12580, which defines responsibilities of EPA and DOD under SARA for National Priority List (NPL) and non-NPL sites.

1.1.1.2 Program Organization

The IRP is a multidisciplinary, phased approach that complies with the requirements of CERCLA, SARA, and the NCP. The initial phase is a records search; the remaining phases are functionally equivalent to the EPA's Remedial Investigation/Feasibility Study Program. The integrated phases of the IRP follow:

- Records Search. The purpose of this phase is to review past and present base activities that result in the generation, accumulation and disposal of hazardous and potentially hazardous wastes. This phase identifies practices or hazardous chemical releases which may have

resulted in environmental contamination. This phase includes a review of base records and interviews with current and former employees. Identified waste sites are rated through the application of the Air Force Hazard Assessment Rating Methodology (HARM). Similar to the EPA Hazard Rating System (HRS), the HARM uses a scoring system to rank sites for priority attention. It takes into account factors such as site and waste characteristics, potential for contaminant migration, and waste management practices. The ranking system is designed to indicate the relative need for follow-up action on potentially contaminated sites to determine whether the site presents a human health or environmental risk. Sites that are rated are reviewed by an Air Force Technical Review panel and classified as ready for remedial action or as requiring further pollution confirmation. Sites which do not receive HARM scores, however, are not necessarily precluded from follow-up action.

- Remedial Investigation/Feasibility Study (RI/FS). The objectives of a RI are to confirm the presence of and to quantify the type and extent of contamination at hazardous material disposal or spill sites identified in the Records Search. Field investigations are performed to determine whether contaminants are present; and, if found, to determine the extent, magnitude, and direction of movement of the contamination. Contaminants identified are evaluated during the feasibility study (FS) to determine whether they can be treated with known technologies. If no treatments are identified, new technologies are developed. The overall objectives of the FS are to recommend, design, build and operate remedial alternatives for each site which protect human health and welfare and the environment. The feasibility of a remedial action is decided upon by the Air Force in conjunction with applicable regulatory agencies. During the RI/FS, meetings are held with federal, state, and local agencies to solicit input regarding the level of effort and specific tasks to be included in the studies.

The RI/FS process facilitates the regulatory review and addresses the need to evaluate remedial alternatives in a timely cost-effective manner.

1.1.2 IRP Long Range Objectives

The long range objectives of the IRP are to accomplish the following:

- Identify past hazardous material disposal and spill sites.

- Fully evaluate the environmental threat posed by these sites.
- Control the migration of hazardous contaminants from designated installations.
- Mediate hazards to public health, welfare and the environment.
- Develop and evaluate necessary remedial actions for sites identified by Air Force, state, and federal regulatory personnel.

1.2 Project Description

1.2.1 Remedial Investigation/Feasibility Study

The objectives of this Quality Assurance Project Plan are to establish field and laboratory analytical and data management protocols necessary for completion of a Stage I Remedial Investigation.

The Records Search for Scott Air Force Base (AFB) was completed in April 1985 by Engineering Sciences, Inc. Seven sites were identified as containing potentially hazardous materials. Subsequent to this determination, a preliminary inspection of each site was conducted by Environmental Resources Management, Inc., (ERM) in conjunction with Base Civil Engineering (BCE), Headquarters Military Airlift Command (HQ MAC), Base Medical Center personnel, and OEHL/TS representatives during the week of June 29, 1987, which identified one additional site as containing a potentially hazardous material. The eight sites requiring further confirmation studies include:

1. Fire Protection Training Area No. 2
2. Landfill
3. Fire Protection Training Area No. 1
4. Facility 8550 Spill Site
5. Fire Protection Training Area No. 3
6. Facility 1965 Spill Site
7. Sludge Weathering Lagoon
8. Old Dental Clinic Site, Facility 1680

The general objective of the Stage I work is to perform field investigations to determine if contaminants are present on designated sites. The specific objectives of RI/FS Stage I are as follows:

- Determine the presence or absence of contamination or contaminated substances within the area of investigation;
- Estimate the magnitude and extent of contamination found;

- Estimate the direction of movement of any contamination found;
- Perform a qualitative risk assessment to determine the potential environmental or health hazards associated with any contaminants found in the local environmental setting, including the identification of physical and chemical characteristics of site contaminants, potential contaminant migration pathways, and human and/or environmental receptors;
- Develop potential general response actions that may be employed for any contamination found; screen technologies based on site conditions, waste characteristics and technical requirements to eliminate those that are inapplicable or infeasible;
- Develop data quality objectives which must be obtained during subsequent field investigations to refine the remedial alternatives for any contamination found;
- Implement the Work Plan and Health and Safety Plan developed in conjunction with this Quality Assurance Project Plan (QAPP).

1.2.2 Site-Specific Work Plans

ERM's proposed site characterization plan is designed to determine whether contaminants are present in ground water, surface water, and soils at the facility and to provide estimates of the extent and magnitude of contamination. The direction and rate of ground water movement will be determined using estimated flow gradients derived from contour maps, average hydraulic conductivity (K) values, and an assumed effective porosity. Based on this information and the results of laboratory analyses, general predictions can be made concerning the extent of contaminant migration. The need for additional monitoring to fill data gaps will also be identified if necessary.

Table 1 presents ERM's recommended laboratory sample collection plan for the sites being studied. Site-specific investigation approaches are presented in the follow sections. Detailed field procedures are discussed below and in Section 5.3 of the Work Plan. A schedule for all field activities is included as Figure 7-1 of the Work Plan.

1.2.2.1 Landfill

The base landfill occupies approximately 60 acres on both the north and south sides of Mosquito Creek in the southeastern

portion of the base. It was operated from the early 1940s to 1976 and is presently occasionally used for disposal of hardfill and sewage treatment plant sludge. The landfill was operated as a trench fill; waste depths are reportedly 30-40 feet.

Ground water, soil, surface water, and sediment will be collected at the landfill. Project field operations will include:

- Soil Gas Survey
- Borehole and Surface Geophysics
- Soil Borings (11)
- Water Table Wells (11)
- Cluster (Deep) Wells (4)
- Surface Water Samples (6)
- Sediment Samples (6)
- Ground Water Samples (15)
- Soil Boring Samples (22)

Collected samples will be analyzed for the parameters indicated in Table 1.

1.2.2.2 Fire Protection Training Area No. 1 (FPTA 1)

The FPTA 1 is located at the northwest corner of the small arms range; it extends approximately 320 feet westward, crossing a portion of East Drive. During monthly fire training exercises conducted at FPTA 1 from 1942 to the early 1950s, several hundred gallons of waste fuels, paint thinners, and oils were deposited directly on the ground and burned. It is estimated that approximately 24000-36000 gallons of liquid waste may have seeped into the gravel covered burn area.

Ground water and soil samples will be collected at FPTA 1. Project field operations will include:

- Surface Geophysics
- Soil Gas Survey
- Soil Borings (3)
- Water Table Wells (3)
- Soil Samples (9)
- Ground Water Samples (3)

Collected samples will be analyzed for the parameters indicated in Table 1.

1.2.2.3 Fire Protection Training Area No. 2 (FPTA 2)

The FPTA 2 is thought to be located adjacent to the southwestern portion of the base landfill; however, its exact location was not determined during initial site reconnaissance. Conversations and

TABLE 1 - PART I: APPROXIMATE NUMBER OF WATER ANALYSES BY SITE

PARAMETER	ANALYTICAL METHOD	LANDFILL	FPTA #1	FPTA #2	FPTA #3	SPILL 8550	SPILL 1965	SLUDGE LAGOON	BLDG 1680	PRIVATE WELL	BACKGROUND	TOTAL
Alkalinity	A403	21	-	-	-	-	-	-	-	-	1	22
Cyanide, Total	SW9010	21	-	-	-	-	-	-	-	-	1	22
Common Anions	E300	21	-	3	-	-	-	3	-	-	1	28
Nitrate-Nitrite	E353.2	21	-	3	-	-	-	3	-	-	1	28
ChlrPhenoxy Herbicides	SW8150	21	-	-	-	-	-	-	-	-	1	22
SpecConductance (Field Test)	E120.1	21	3	3	3	3	3	3	-	1	1	41
pH (field test)	E150.1	21	3	3	3	3	3	3	-	1	1	41
Temp (field test)	E170.1	21	3	3	3	3	3	3	-	1	1	41
TDS	E160.1	21	-	3	-	-	-	3	-	-	1	28
Metals Screen*	SW3005/6010	42	-	6	-	-	-	6	-	-	2	56
Arsenic*	SW3005/7060	42	-	6	-	-	-	6	-	-	2	56
Mercury*	SW3005/7470	42	-	6	-	-	-	6	-	-	2	56
Selenium*	SW3005/7740	42	-	6	-	-	-	6	-	-	2	56
Lead*	SW3005/7421	42	6	6	6	-	6	6	-	-	2	74
*Total&Dissolved; Boron and Silica excluded from SW6010												
PetrHydrocarbon	E418.1	21	3	3	3	3	3	3	-	1	1	41
Halogenated VOCs	SW5030/8010	21	3	3	3	3	3	3	-	1	1	41
Non-halogenated VOCs	SW5030/8015	21	-	-	-	-	-	-	-	-	1	22
Aromatic VOCs	SW5030/8020	21	3	3	3	3	3	3	-	1	1	41
OrganoChlorine Pesticides & PCBs	SW3510/8080	21	-	-	-	-	-	-	-	-	1	22
1,2Dibromoethane	E502.1	-	-	-	-	-	-	3	-	-	1	4
Semi-VOCs	SW3510/8270	21	3	3	3	3	3	3	-	1	1	41

TABLE 1 - PART II: APPROXIMATE NUMBER OF SOIL ANALYSES BY SITE

PARAMETER	ANALYTICAL METHOD	LANDFILL	SPILL					SLUDGE		DRILL		TOTAL
			FPTA #1	FPTA#2	FPTA #3	8550	1965	LAGOON	BLDG 1680	BCKGRD	CUTTINGS	
Cyanide, Total	SW9010	28	-	-	-	-	-	-	-	3	-	31
PetrHydrocarbon	SW3550/418.1	28	18	9	12	8	16	8	-	3	-	102
Metals Screen	SW3050/6010	28	-	9	-	-	-	8	-	3	-	48
Mercury	SW3050/7471	28	-	9	-	-	-	8	20	3	-	68
Lead	SW3050/7420	-	18	-	12	-	16	-	-	3	-	49
OrganoChlorine Pesticides & PCBs	SW3550/8080	28	-	-	-	-	-	-	-	3	-	31
ChlrPhenoxy Herbicides	SW8150	28	-	-	-	-	-	-	-	3	-	31
Volatile Organics	SW8240	28	18	9	12	-	-	8	-	3	20	98
Semi-VOCs	SW3550/8270	28	18	9	12	8	16	8	-	3	20	122
Soil Moisture	ASTM D2216	28	18	9	12	8	16	8	20	3	-	122
EP Toxicity (Metals only)	SW1310	-	-	-	-	-	-	-	-	-	20	20

meetings with former base fire company personnel will be used to determine the exact location of FPTA 2 prior to any field operations.

The FPTA 2 was used from the early 1950s to 1969. During biweekly to monthly fire training exercises approximately 300-500 gallons of waste combustibles including paint thinners and oils were deposited directly on the ground and burned. It is anticipated that some liquid wastes deposited on the burn area have seeped into the gravel-covered burn area.

Ground water and soil samples will be collected at FPTA 2. Project field operations and sample collection will include:

- Surface Geophysics
- Soil Gas Survey
- Soil Borings (4)
- Water Table Wells (3)
- Soil Samples (8)
- Ground Water Samples (3)

Collected samples will be analyzed for the parameters indicated in Table 1.

1.2.2.4 Fire Protection Training Area No. 3 (FPTA 3)

The FPTA 3 is located northeast of Locust Street, southeast of Taxiway "B". It was used in a manner similar to that of FPTAs 1 and 2 from 1969 to 1979. In 1979, a fuel recovery system was installed and presently operates to collect unburned fuel from on-going fire training exercises. It is estimated that approximately 100,000 gallons of liquid waste may have seeped into the gravel covered burn area prior to installation of the fuel recovery unit.

Ground water and soil samples will be collected at FPTA 3. Project field operations and sample collection will include:

- Surface Geophysics
- Soil Gas Survey
- Soil Borings (4)
- Water Table Wells (3)
- Soil Samples (12)
- Ground Water Samples (3)

Note that water table wells will be flush mounted in the area since fire protection training exercises continue at this location.

Collected samples will be analyzed for parameters indicated in Table 1.

1.2.2.5 Facility 8550 Spill Site

Facility 8550 is a JP-4 fuel storage tank located at the southern boundary of the base approximately 1200 feet southwest of Taxiway "H". In 1977 approximately 13,000 gallons of JP-4 were not recovered during clean up of a 120,000 gallon spill at the facility. It is unknown whether this fuel breached the dike surrounding tank 8550 or seeped into materials used to construct the protective dike.

Ground water and soil samples will be collected at the 8550 spill site. Project field operations and sample collection will include:

- Surface Geophysics
- Soil Gas Survey
- Soil Borings (4)
- Water Table Wells (3)
- Soil Samples (8)
- Ground Water Samples (3)

Soil and ground water samples will be analyzed for the parameters indicated in Table 1.

1.2.2.6 Facility 1965 Spill Site

Facility 1965, the BX Service Station is located at the intersection of Scott Drive and E. Winters Street. In the mid 1970s, petroleum odors were detected in sanitary sewer lines adjacent to the station and were attributed to a leaking underground storage tank at the service station. The tank was repaired; however, it is not known how long the tank may have leaked or the extent of potential contamination.

Ground water and soil samples will be collected at the Service Station. Project field operations and sample collection will include:

- Soil Borings (4)
- Water Table Wells (3)
- Soil Samples (16)
- Ground Water Samples (3)

Collected samples will be analyzed for the parameters indicated in Table 1. Note that the location of soil borings and monitoring wells at the service station is constrained by underground gasoline lines and tanks. In addition, it is anticipated that base support relative to the coordination of traffic control in the area and station operation will be provided.

1.2.2.7 Sludge Weathering Lagoon

A small earthen sludge weathering lagoon was constructed southeast of POL tanks 8552 and 8554 during the mid 1970s for use in weathering tank bottom sludges removed from the POL tanks. This lagoon was reportedly also used for disposal of other industrial waste liquids including paint, paint thinners and waste oils. The use of this lagoon was limited to one to two years; in the late 1970s, the lagoon was excavated and soils to a depth of 2 feet removed for off-site disposal. The area was backfilled with sand and gravel; however, no testing for soil and/or ground water contamination was conducted. Presently the area is not noticeable due to ground cover.

Ground water and soil samples will be collected in the area of the lagoon. Project field operations and sample collection will include:

- Surface Geophysics
- Soil Gas Survey
- Soil Borings (4)
- Water Table Wells (3)
- Soil Samples (8)
- Ground Water Samples (3)

Collected samples will be analyzed for the parameters indicated in Table 1.

1.2.2.8 Building 1680

Building 1680, located at the corner of W. Martin and "J" Streets, housed the base dental facilities since the late 1940s. This building was constructed with earthen crawl space below the building. Mercury containing amalgams, used for dental fillings, have reportedly contaminated the soils below the building.

Shallow soil samples will be collected at 20 locations below the building. These samples will be analyzed for total mercury only. During sampling, a mercury vapor analyzer will be used to monitor mercury vapors in the areas of sample collection.

1.2.2.9 Background Soil and Water Sampling

One water table well will be completed in an area of the base believed to be uncontaminated. Subsurface soil samples (a maximum of 3) will be collected during well installation. Both soil and water samples will be analyzed for the parameters indicated in Table 1.

1.3 Project Organization and Responsibility

While all personnel involved in an investigation and in the generation of data are implicitly a part of the overall project and quality assurance program, certain individuals have specifically delegated responsibilities. Within ERM these are the Project Manager, the Quality Assurance Manager, the RI Task Manager, the Quality Assurance Officer, the Field Operations Manager, and the Project Technicians. Weston Analytics, Inc. of Lionville, Pennsylvania, will provide all analytical services for this investigation. Specific laboratory personnel with quality assurance/quality control responsibilities include the Laboratory Quality Assurance Officer and Laboratory Sample Custodian. Figure 1 presents a project organization flow chart. USEPA Region V personnel have been responsible for review of this QAPP and will be responsible for auditing field operations.

1.3.1 Project Manager

Dr. James Talbot is Project Manager for the Scott Air Force Base RI/FS. The Project Manager maintains routine contact with the investigation's progress, regularly reviews the project schedule, and reviews all major work elements prior to submittal. The Project Manager oversees all scheduling and budgeting, and serves as the prime contact with local, state, and federal agencies.

1.3.2 Quality Assurance Manager

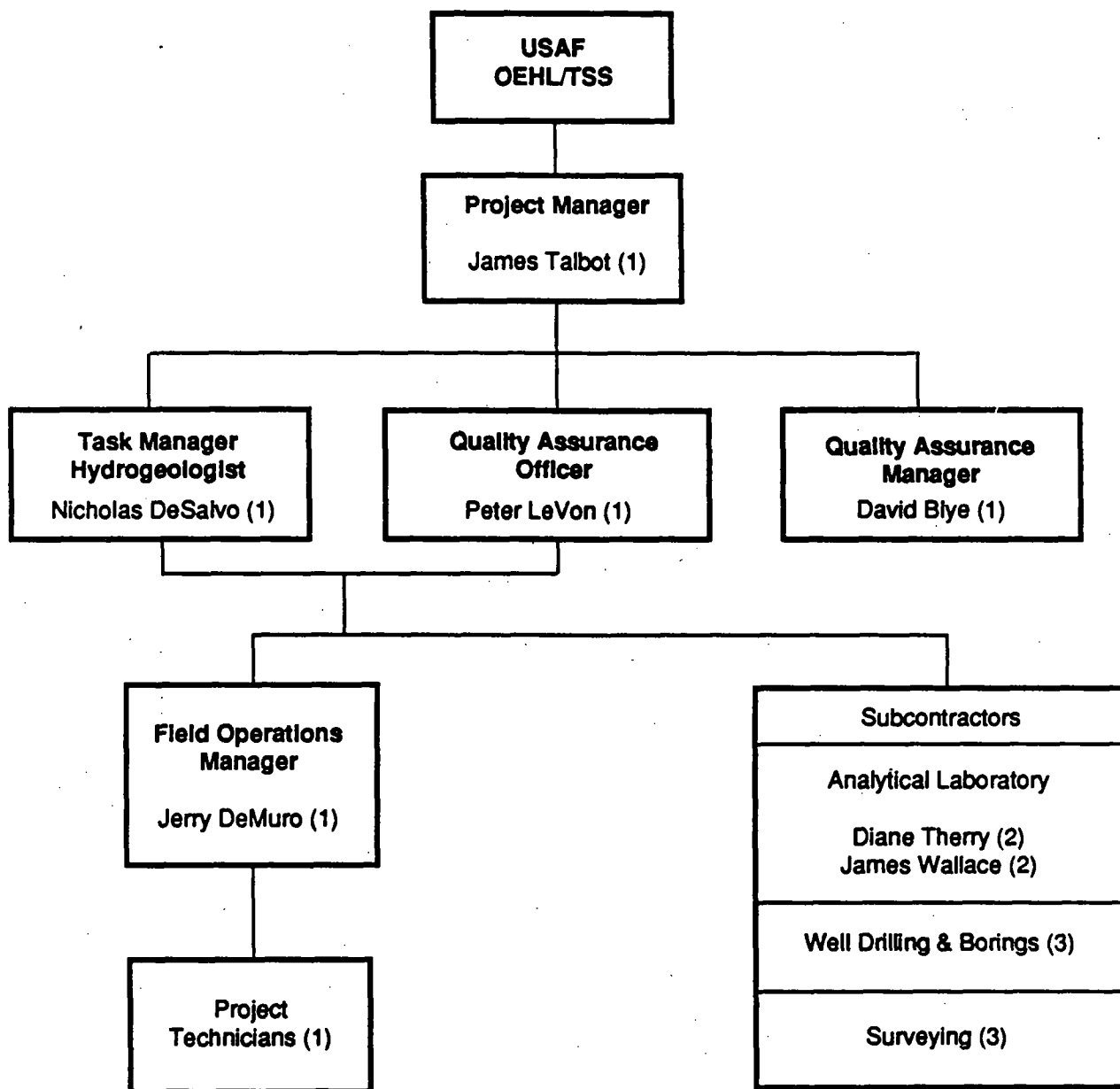
Mr. David Blye serves as Quality Assurance Manager on all projects requiring the collection of data, and as such is not directly involved in the routine performance of technical aspects of the investigation.

It is the Quality Assurance Manager's responsibility to develop, evaluate and to document the Quality Assurance Project Plan and procedures appropriate to the investigation. Additionally, it is the Quality Assurance Manager's responsibility to review all project plans and revisions to the plans to assure proper quality assurance is maintained. Frequent and regular meetings will take place between the Quality Assurance Manager and the Quality Assurance Officer to review all quality assurance activities. The Quality Assurance Manager is also responsible for all data processing activities, data processing quality control, and data quality review, including review of Tentatively Identified Compounds.

1.3.3 RI Task Manager

Mr. Nicholas DeSalvo will serve as RI Task Manager for this investigation, with the responsibilities of implementing the Work Plan and overseeing the day-to-day activities of all work to be conducted including that of subcontractor personnel.

Figure 1
Project Organization Chart



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Exton, Pa. 19341
(215) 524-3500

(2) Weston Analytics, Inc.
208 Welsh Pool Road
Lionville, Pa. 19353
(215) 524-7360

(3) To be determined

1.3.4 Quality Assurance Officer

Dr. Peter LeVon will serve as the Project Quality Assurance Officer. The Quality Assurance Officer has primary responsibility for overall project quality assurance. The Quality Assurance Officer is responsible for field and laboratory audits, field quality assurance, and all other non-analytical data quality review. It is a major responsibility of the Quality Assurance Officer to insure that all personnel have a good understanding of the project quality assurance plan, an understanding of their respective roles relative to one another, and an appreciation of the importance of the roles to the overall success of the program.

1.3.5 Field Operations Manager

It is ERM's policy that a Field Operations Manager/Project Geologist be assigned to large-scale projects where the Task Manager cannot be present for all on-site activities. Mr. Jerry DeMuro will serve as the Field Operations Manager. The Field Operations Manager reports directly to the RI Task Manager and is immediately responsible for the day-to-day activities of all ERM field personnel. Further responsibilities include the verification for accuracy of field notebooks, driller's logs, chain-of-custody records, sample labels, and all other field-related documentation.

1.3.6 Project Technicians

Ground water, soil, and air sampling tasks required by this investigation will be conducted by experienced environmental technicians. Their responsibilities will include the documentation of the proper sample collection protocols, sample collection and field measurements, equipment decontamination, and chain-of-custody documentation.

1.3.7 Laboratory's Quality Assurance Coordinator

The volume of analytical work for a project of this size necessitates the subcontract analytical laboratory specify a Quality Assurance Coordinator whose duties are specific to the project. Ms. Dianne Therry will serve as Weston Analytic's Quality Assurance Coordinator with the responsibility for maintenance of all laboratory quality assurance activities in association with the project.

1.3.8 Laboratory Sample Custodian

Mr. James Wallace will serve as project Laboratory Sample Custodian for Weston Analytics. The Sample Custodian's

responsibilities include insuring proper sample entry and sample handling procedures by laboratory personnel.

1.4 Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Comparability, and Completeness

1.4.1 Overall Project Objectives

Data Quality Objectives (DQO) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. DQO define the total uncertainty in the data that is acceptable for each specific activity during the investigation. This uncertainty includes both sampling error and analytical error. Ideally, the prospect of zero uncertainty is the intent; however, the variables associated with the process (field and laboratory) inherently contribute to the uncertainty of the data. It is the overall objective to keep the total uncertainty within an acceptable risk that will not hinder the intended use of the data. In order to achieve this objective, specific data quality requirements such as detection limits, criteria for accuracy and precision, sample representativeness, data comparability and data completeness will be specified. The overall objectives and requirements will be established such that there is a high degree of confidence in the data measurements. The data collected during the course of the investigation will be used to answer the following questions:

1. Are contaminants present or absent? (qualitatively)
2. If contaminants are present, what are the types or classes present?
3. What quantities (concentrations) of contaminants are present (quantitative)?
4. What are the pathways for contaminant release?
5. What are the boundaries of contaminant sources and pathways?
6. What are the environmental/public health factors?
7. What are the contaminant characteristics with respect to migration?

The media that will be sampled to answer these questions will be ground water, surface water, soils, and sediments. The specific analytical parameters for the samples collected during the

investigation are specified in the Work Plan and detailed in Table 1.

As stated earlier, the indicators that will be used to specify data quality requirements and to evaluate the analytical system performance are precision, accuracy, representativeness, completeness and comparability (PARCC). Table 2 presents definitions for these indicators.

1.4.2 Field Investigation Data Quality Objectives

The objectives with respect to the field investigation are to maximize the confidence in the data in terms of PARCC.

In terms of precision and accuracy, Section 1.10 presents the frequency with which blanks, duplicates, replicates and matrix spike samples will be collected so that the specific degree of precision and accuracy can be calculated. The data quality objective for field duplicates is to achieve precision equal to or greater than laboratory duplicate precision requirements established in the EPA's Contract Laboratory Program (CLP) Statement of Work (SOW) (organic and inorganic).

Acceptable soil sample precision can be attained by careful sample homogenizing (except for aliquots designated for volatile organic analysis). Precision will be calculated as relative percent difference (RPD) if there are only two (2) analytical points and relative standard deviation (RSD) if there are more than two (2) analytical points. The following equations will be used to calculate RPD and RSD:

$$RPD = \frac{M_1 - M_2}{(M_1 + M_2)/2} \times 100$$

(where M_1 and M_2 are measurements 1 and 2, respectively)

$$RSD = \frac{SD}{\bar{x}} \times 100$$

(where SD is the standard deviation and \bar{x} is the mean).

The submission of various types of blanks will provide a check with respect to the introduction of contamination. Therefore, the submission of blanks will monitor errors associated with the

TABLE 2

DEFINITIONS OF DATA QUALITY INDICATORS
AND METHODS OF ASSESSMENT

- Precision - a measure of the reproducibility of measurements under a given set of conditions. Precision will be assessed by analyzing laboratory duplicates (from the same sample jar) and will be calculated as relative percent difference (RPD).
- Accuracy - a measure of the bias that exists in a measurement system. Matrix spike samples performed at the laboratory will be used to assess accuracy which will be expressed in terms of percent recovery.
- Representativeness - the degree to which sample data accurately and precisely represent selected characteristics. Field replicate samples will be used to assess representativeness which will be expressed in terms of RPD.
- Completeness - a measure of the amount of valid data obtained from the measurement system compared to the amount that was expected under ideal conditions. Completeness will be calculated as the valid data percentage of the total tests performed.
- Comparability - a measure that expresses the confidence with which one data set can be compared with another. Comparability will be maximized by utilizing standardized procedures for field and laboratory operations (i.e., sample collection, analytical method, etc.).

sampling process, field contamination, preservation, handling, and laboratory contaminants. The data quality objective for all blanks is to meet or exceed those criteria established in the EPA's CLP SOW (organic and inorganic). In the event that the blanks are contaminated and/or poor precision is obtained, the associated data will be qualified as described in Section 1.9. Through the submission of field QC samples the distinction can be made between laboratory problems, sampling technique, and sample matrix variability.

Precision and accuracy for the field pH and conductivity are dependent on the type and condition of the instrument used and the care used in its standardization and operation. The precision and accuracy objectives for the instrumentation used are presented in Table 3.

To ensure sample representativeness, all sample collection will be performed in strict accordance with the U.S. EPA-recommended procedures for the collection, preservation, and holding times specified in EPA 600/4-79-020 (Methods for Chemical Analysis of Water and Wastes), the Federal Register, 26 October 1984, and other documents noted in Section 1.5.

The data quality objective for the completeness of data with respect to the sampling (field investigation) is 100%. Every effort will be made to obtain valid data for all sampling points, particularly those classified as critical points. Critical sampling points are those which will be used to directly answer questions posed in the design of overall project objectives (Section 1.4). Those sampling points identified as critical will necessarily be selected as QC samples (duplicate and matrix spike) at the frequency specified in Section 1.10.

In order to establish a degree of comparability such that observations and conclusions can be directly compared with historical and/or future data, ERM will use standardized methods of field analysis, sample collection, holding times and preservation. In addition, field conditions (i.e., weather, temperature) will be considered prior to sampling in order to attain a high degree of data comparability. For example, collection of volatile organic samples under widely varying temperatures (i.e., winter vs. summer) may influence data comparability via analyte losses during a hot weather sampling event. For reasons such as this, ERM will attempt to minimize sampling under adverse conditions in the field.

1.4.3 Laboratory Data Quality Objectives

The laboratory will demonstrate analytical precision and accuracy by the analysis of laboratory duplicates and matrix spikes. Laboratory accuracy will be demonstrated by the addition of surrogate and matrix spike compounds/constituents. Accuracy

TABLE 3
CRITERIA OBJECTIVES

<u>Precision Objectives</u>	<u>Aqueous</u>	<u>Solid/Other</u>
Field Measurements		
pH	+ 0.1 standard units (SU)	
Conductivity	+ 10/+ 25/+ 250 umhos/cm ¹	
Temperature	+ 0.5 degrees C	
Laboratory Duplicates and Field Replicates (Unspiked)		
Volatiles (all classes)	within 20% RPD ²	within 30% RPD
Extractables (BNAs)	within 25% RPD	within 40% RPD
Pesticides/PCBs	within 25% RPD	within 50% RPD
Metals	within 20% RPD	within 25% RPD
Petroleum Hydrocarbons	within 25% RPD	within 40% RPD
Laboratory Duplicates (MSD) ³		
Volatiles	As specified in EPA's current SOW	
Extractables	As specified in EPA's current SOW	
Pesticides/PCBs	within 25% RPD	within 50% RPD
Petroleum Hydrocarbons	within 25% RPD	within 40% RPD
<u>Accuracy Objectives</u>		
Field Measurements		
pH	+ 0.1 SU	
Conductivity	varies with reading ⁴	
Temperature	+ 0.5 degrees C	
Blanks: Field or Trip Blanks		
(All fractions)	Less than the quantitation limit	
Laboratory blanks		
(All fractions)	Less than twice the quantitation limit	
Spikes: Matrix Spikes		
Volatiles (all classes)	85-115% recovery	80-120% recovery
Extractables (BNAs)	As specified in EPA's current SOW	
Pesticides/PCBs	70-110% recovery	50-95% recovery
Metals	80-120% recovery	75-115% recovery
Petroleum Hydrocarbons	80-120% recovery	60-115% recovery
Surrogates		
(All fractions)	As specified in EPA's current SOW	

TABLE 3 (continued)

Representativeness Objectives

Field Duplicates

(Blind or Labeled)

Volatiles (all classes)	within 20% RPD	within 30% RPD
Extractables (BNAs)	within 25% RPD	within 40% RPD
Pesticides/PCBs	within 25% RPD	within 50% RPD
Metals	within 20% RPD	within 25% RPD
Petroleum Hydrocarbons	within 25% RPD	within 40% RPD

Completeness

All data will be assessed in terms of completeness by undergoing a rigorous review with a 100% objective. Valid data will be complete without qualification, while data considered deficient will be qualified, and their significance to the project objectives described.

Comparability

All field and laboratory methods will be standardized to provide maximum comparability both within the overall investigation and with external sources of data.

Notes:

1. Precision as stated for the 500, 5000 and 50000 umhos/cm ranges respectively
2. RPD = relative percent difference
3. MSD = matrix spike duplicate
4. Accuracy varies with conductivity reading as shown in Attachment 3 YSI Model 33 SCT Meter Instructions, page 7 (Figure 2).

will be presented as percent recovery. Precision will be presented as RPD, RSD (as defined previously in Section 1.4.2), or percent difference (PD, defined below) whichever is applicable to the specific type of QC samples. Percent difference will be calculated using the following equation:

$$PD = \frac{X_2 - X_1}{X_2} \times 100$$

where X_2 is the new value and X_1 is the previous value for a given analytical result.

The frequency of laboratory duplicates, matrix spikes and laboratory blanks are specified in Section 1-10. As considerable reference is made to Attachment 1 in the remainder of this QAPP, it is suggested that it be reviewed at this time. Weston Analytics' data quality objectives are detailed in Attachment 1 of this QAPP.

The analytical laboratory will be expected to process (purge, extract or digest) an aliquot of sample such that the analytical results will provide a high degree of representativeness with respect to each sample collected. In addition, the analytical laboratory will be expected to document all analytical problems encountered during the course of the investigation. This will enable ERM to achieve a 100% completeness goal. Further, the laboratory will be required to provide all data in the following data package deliverables to ensure that analytical methods, parameters, and reporting units are comparable with other existing and/or future data.

Weston Analytics, Inc., Level II data reports include the following:

- o cover page
- o chain of custody/sample request form
- o case narrative laboratory chronicle
- o tune summaries
- o sample data summaries
- o QC data including:
 - method blanks
 - surrogate recoveries
 - matrix spike/matrix spike duplicate recoveries
 - individual sample data (forms)
 - total ion chromatograms for samples
 - chromatograms of standards.

1.4.4 Criteria Objectives

The quantitative objectives (criteria) that ERM will require for both field and laboratory accuracy and precision were summarized in Table 3.

The laboratory will be expected to report the method detection limits (MDL) for all samples in the appropriate statistical reporting units for all analyses as stated in specific EPA methods used by the analytical laboratory. However, it should be noted that actual detection limits are sample-specific and depend on variables such as dilution factors, sample matrices and the specific analyte. The handling of data reported at or near the MDL will be done cautiously, since the stated data quality objectives for accuracy and precision may not "translate" well in these cases.

1.4.5 Data Management Objectives

It is a data management objective that all aspects of the investigation from sample design, collection, shipment, analysis, use/decisions be performed in conjunction with rigorous QA/QC documentation. The specific details of this documentation can be found throughout this document and the associated work plan.

It is expected that by the design of separate data quality requirements for field sampling and laboratory analysis, clear distinctions can be made such that any problems found in the system can be isolated with respect to the cause. Conversely, the data quality requirements are also designed to provide an indication of the variability inherent to the overall system.

Through sampling, analysis, data assessment (data review), data qualification, and feedback, the overall data management objective is to provide a complete data base with a high degree of confidence that will thoroughly characterize the various study areas.

In terms of reporting data collected during the study, a hard copy of the field and laboratory test results will be submitted with the monthly progress report. Data collected in this effort will be archived with Air Force-compatible computer hardware and software and forwarded to USAFOEHL/TS per format and media instructions provided in the latest version of the OEHL Handbook, Section 7.

With regard to archiving data and information generated under this RI/FS project, OEHL/TS will maintain a file on all data and information collected. The administrative record for the project will be kept by the SCOTT AFB Environmental Coordinator.

1.5 Sampling Procedures (References)

The collection of all environmental samples will be performed in strict accordance with U.S. EPA-recommended procedures as specified in the following documents:

EPA-600/4-79-020	Methods for Chemical Analysis of Water and Waste
40 CFR Part 136	The Federal Register, Friday, Oct. 26, 1984.
EPA-SW846	Test Methods for Evaluating Solid Waste, 3rd Edition, (1986).
EPA-330/9-81-002	NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Waste Sites.
EPA-600/4-83-040	Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods.
EPA-600/54-83-002	Protocol for Soil Sampling: Techniques and Strategy.

With respect to the aforementioned documents, generalized sampling procedures used by ERM are presented as Attachment 2, "Standard Operating Procedures for the Collection of Environmental Samples". The sampling protocols are applicable to a wide type of environmental investigations. Site-specific procedures are presented in Section 2.4 of this QAPP.

1.6 Sample Custody

The primary objectives of sample custody procedures are to create accurate written records which can be used to trace the possession and handling of all samples from the moment of their collection, through analysis, until their final disposition. Sample custody for samples collected during this investigation will be maintained by the Field Operations Manager (FOM) or the field personnel collecting the samples. The FOM or field personnel are responsible for documenting each sample transfer and maintaining custody of all samples until they are shipped to the laboratory.

1.6.1 Chain-of-Custody, Sample Handling, Packaging and Shipping

All necessary sample bottles will be shipped to ERM by Weston Analytics and received by the FOM or field personnel. Chain-of-Custody will begin when the laboratory releases the sample

bottles. All necessary chemical preservatives will be added to the bottles by ERM immediately upon bottle receipt. Sample bottles needed for a specific sample task will then be relinquished by the FOM to the sampling team after the FOM has verified the integrity of the bottles and assured that the proper bottles have been assigned to the task to be conducted.

A self-adhesive sample label (Figure 2) will be affixed to each container before sample collection to minimize label loss during handling of the container. At a minimum, the sample label will contain:

- Client - Job Name (Scott AFB)
- ERM Traffic Report Number
- Sample identification - place of sampling
- Date and time collected
- Sampler's initials
- Testing required
- Preservatives added

Immediately after sample collection, each sample bottle will be sealed in an individual plastic bag. Samples will then be placed immediately into an insulated cooler for shipment to the laboratory. ERM field Chain-of-Custody records (Figure 3) and an ERM Traffic Report (Figure 4), completed at the time of sample collection, will accompany the samples inside the cooler for shipment to the laboratory. The samples will be properly relinquished on the field Chain-of-Custody record by the sampling team. These record forms will be sealed in a ziplock plastic bag to protect them against moisture. Each cooler will contain sufficient ice and/or ice packs to insure that proper temperature is maintained, and will be packed in a manner to prevent damage to sample containers. The FOM will then initial, date and custody seal (Figure 5) each sample cooler. All coolers will be shipped by an overnight courier according to current US DOT regulations. Prior to releasing the coolers, the FOM will require the courier to sign an ERM Cooler Transfer Acknowledgment (Figure 6). Upon receiving the samples, the laboratory Sample Custodian will inspect the condition of the samples, compare the information on the sample labels against the field Chain-of-Custody record and Traffic Reports, assign a Weston Analytics control number, and log the control number into the computer sample inventory system. A detailed description of this log-in procedure is given in Attachment 1, Section 5.1.

The preparation of all sample bottles (cleaning technique, preservative added, etc.) will be documented. When samples requiring preservation by either acid or base are received at the laboratory, the pH will be measured and documented. The Laboratory Sample Custodian will then store the sample in a

FIGURE 2
SAMPLE BOTTLE LABEL


		208 WELSH POOL ROAD PICKERING CREEK INDUSTRIAL PARK LIONVILLE, PA 19353 PHONE: (215) 524-7360 TELEX: 83-5348											
CHEMICAL ANALYSES: 													
SAMPLE DATA: Client _____ Project/Site _____ Date/Time _____ Sample ID _____ Location _____ Collector _____		PRESERVATIVE: <table style="width: 100%; border: none;"> <tr> <td>_____ None</td> <td>_____ Sterile</td> </tr> <tr> <td>_____ HNO₃</td> <td>_____ MeOH</td> </tr> <tr> <td>_____ H₂SO₄</td> <td>_____ MeCl₂</td> </tr> <tr> <td>_____ ZnAc/NaOH</td> <td>_____ Other</td> </tr> <tr> <td>_____ NaOH</td> <td>(specify)</td> </tr> </table>		_____ None	_____ Sterile	_____ HNO ₃	_____ MeOH	_____ H ₂ SO ₄	_____ MeCl ₂	_____ ZnAc/NaOH	_____ Other	_____ NaOH	(specify)
_____ None	_____ Sterile												
_____ HNO ₃	_____ MeOH												
_____ H ₂ SO ₄	_____ MeCl ₂												
_____ ZnAc/NaOH	_____ Other												
_____ NaOH	(specify)												



Figure 3
ERM Chain of Custody Record



1	Project W.O. #	2	Sample Concentration	No 2561	
	Project Name/Location		<input type="checkbox"/> Low Concentration		
			<input type="checkbox"/> Medium Concentration	3	Ship to:
		5	Sample Matrix		
4	Sampling Personnel Contact		<input type="checkbox"/> Liquid		
	Sampler _____ Project Manager		<input type="checkbox"/> Solid		
	Phone #		<input type="checkbox"/> Other _____	Attn:	
6	Shipping Information	7	Specify Number of Containers, Approximate Volume and the Type of Analyses Requested		
	(Name of Carrier)				
	(Date Shipped)		ANALYSES/METHOD REQUESTED	# OF BOTTLES	TOTAL VOLUME
	(Airtail Number)				
8	Sample Location				
	Date:				
	Time:				
9	Sample Description	10	Special Handling (e.g. Safety Procedures/Hazardous)		
	<input type="checkbox"/> Surface Water <input type="checkbox"/> Soil				
	<input type="checkbox"/> Ground Water <input type="checkbox"/> Solid				
	<input type="checkbox"/> Leachate <input type="checkbox"/> Other _____		Additional comments:		
	<input type="checkbox"/> Sediment				
11	Condition of Samples Received (to be completed by Laboratory Log-in.)				
	<input type="checkbox"/> Samples received intact				
	<input type="checkbox"/> Samples at 4 degrees (C)				Log-In Person's Signature
	<input type="checkbox"/> Samples not leaking				
	<input type="checkbox"/> Container numbers match as specified in item 7				
	<input type="checkbox"/> Container tags match Chain of Custody				
	<input type="checkbox"/> Cooler received with Custody Seals intact				

Figure 5
ERM Custody Seal

ERM OFFICIAL CUSTODY SEAL	Name: _____ Date : _____
--	-----------------------------

ERM Cooler Transfer Acknowledgement

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secure sample storage cooler maintained at 4°C and maintain custody until assigned to an analyst for analysis.

The Laboratory Sample Custodian will note any damaged sample containers or discrepancies between the sample label and information on the field Chain-of-Custody record when logging the sample and will note any discrepancies in Section 11 of the ERM Traffic Report. This information will also be communicated to the FOM or field personnel so proper action can be taken. The Chain-of-Custody form will be signed by both the relinquishing and receiving parties each time the sample changes hands, and the reason for transfer indicated.

An internal Chain-of-Custody form will be used by Weston Analytics to document sample possession from laboratory Sample Custodian to Analysts and final disposition (Attachment 1, Section 5.0). All Chain-of-Custody information will be supplied with the data packages for inclusion in the document control file.

1.6.2 Documentation of Field Activities

ERM will require a rigorous data control program that will insure that all documents for the investigations are accounted for when they are completed. Accountable documents include items such as log books, field data records, correspondence, chain-of-custody records, traffic reports, data packages, photographs, computer disks, and reports. The Project Manager is responsible for maintaining a central file in which all accountable documents will be inventoried. The Air Force will, however, be responsible for maintaining the final evidence file.

To maintain control in the transfer of data, all copies of raw data from the field notebooks, and the data as received from the laboratory, will be entered into a data file and assigned an appropriate document control identification number. The data file will serve as the ultimate archive for all information and data generated during this investigation.

The documentation of sample collection will include the use of bound field log books in which all information on sample collection will be entered in indelible ink according to the procedure described below. Appropriate information will be entered to reconstruct the sampling event, including: site name (top of each page), sample identification, brief description of sample, date and time of collection, photographs, sampling methodology, field measurements and observations, and sampler's initials (bottom of each page, and dated). An example of a field log is presented in Figure 7. If a mistake is entered into any documentation, a single line will be placed through the error and the author will initial and date the correction.

FIGURE 7
Typical Logbook Entries

5-8-87 Scott AFB

Personal Present:

Weather Description:

Field Tasks, Observations, Notes
on Samples Collected:

ODORS OBSERVED:

COLOR OF SAMPLE:

TEXTURE OF SAMPLE:

Location of Sample

Depth-to-Water

Depth-to-Bottom

Purge Volume

Purge Method

Physical Observations

(i.e. odor, sheen)

Field Measurements

pH, Specific

Conductance

Sample Collection Equip.

Time of Collection, ERM T.R.#

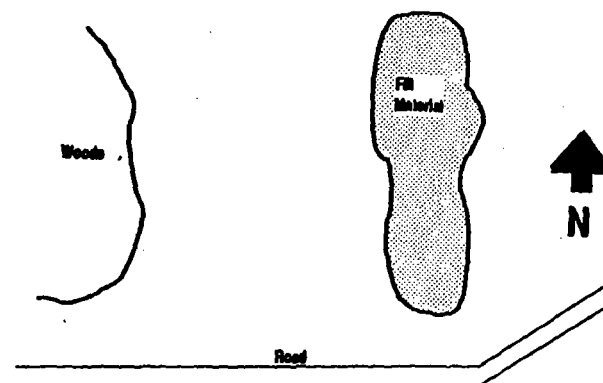
Equipment Calibration:

Decontamination Methods Used:

Scott AFB

5-8-87

Relevant Sketch:
(or attach location map)



1.6.2.1 Field Sampling Log Books

One or more bound books will be maintained for each site; the book(s) will remain with the site evidence file. Copies should be made for the person who made the entries and the PM if requested.

All entries in the Logbook must be made in ink.

First Page should contain:

- Site name and number
- Date and time started
- Personnel on site

Next page(s) should contain depth to water (DTW) for all wells if required by the sampling plan; serial number of the DTW meter.

Each new day should contain:

- Date and time started
- Weather
- Personnel on site - including any non-ERM personnel
- Sampling information (see next section)

* Note: when a mistake is made in the Log, put a single line through it in ink and initial and date.

1.6.2.2 Sample Information

- Sample # (Traffic Report)
- Date and Time Sample collected
- Source of Sample (well, stream, domestic well, field, etc.)
- Location of Sample - document with a site sketch and/or written description where sample was taken so that it could be found again.
- How was sample taken? (bailer, trowel, SS spoon, thief, etc.)
- Analysis and QA/QC required (601, 602, Metals, Tier I, Tier II, etc.)
- Chemical Preservation used (HNO₃, H₂SO₄, NaOH, etc.)
- Field Data (pH, DO, spec. and temp., etc.)

- Field Observations - significant observation should be documented.
 - Sample condition (color, odor, turbidity, oil, sheen)
 - Site condition (stressed vegetation, exposure of buried wastes, erosion problems, etc.)
- How sample was shipped, date, time and where to, and whether legal seals were attached to transport container(s).
- Comments - Any observation or event that occurred that would be relevant to the site; for example, weather changes or effect it had on sampling, conversations with the client, public official or private citizen; instrument calibration, equipment problems, etc.

A photographic log will be prepared to visually account for various sampling events and field activities. The backs of all photographs will include a separate photo "number" which will enable the photo to be tracked back to the log book. This is in addition to the standard information (i.e., site name, place of sampling, date, time, photo description, signature and name of photographer). In addition, a photo number, as used in the report, will be included on the photo. An example of photograph documentation is presented in Figure 8.

1.7 Calibration Procedures and Frequency

1.7.1 Laboratory Calibration

Laboratory calibration and frequency for the required methods specified for this study are presented in Attachment 1, Section 6.

1.7.2 Field Calibration

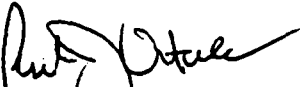
In addition to the laboratory analyses conducted during the course of this investigation, field measurements of pH, specific conductance, and temperature will be taken for all surface and ground water samples. An OVA meter will be used to measure total volatile organics in air or soil headspace.

The frequency of field calibration procedures will, at a minimum, include the following:

- The pH and specific conductance meters will be calibrated a minimum of once daily and documented in the

Figure 8

Photograph Documentation

SCOTT AFB 44502-01-01	R1P1 Photo #5	This number indicates the picture was identified as roll #1, photo #1 in the field logbook. This will be written in ink
View of Fire Training Area 1234 looking North towards the flagpole.		
9/25/87	1300	This number indicates the designation in the report photo log .
 Rock J. Vitale		

calibrator's field book. Calibration will be checked as necessary to insure proper measurements are taken.

- pH meters will be calibrated using specific techniques according to the manufacturer's instructions using two standard buffer solutions (either 4 or 7, and 10) obtained from NBS. The pH values of these buffers will be compensated for temperature according to the values supplied on the manufacturer's bottle label. The temperature (measured as below) at which the sample pH was measured will then be used to compensate for temperature on the meter.
- Temperature measurements will be performed using field thermometers (Thomas Science No. 9329A10).
- Specific conductance meters will be calibrated using a 1413.0 umho (KCl) solution prepared by ERM according to Standard Methods for the Analysis of Water and Wastewater, 16th Edition, 1985, Method 205, 3b, page 79. The conductivity probe cell constant will be calculated according to the formula:

$$K = \frac{1413.0 \frac{1}{(C)}}{1 + 0.02 (T - 25^{\circ}\text{C})}$$

Where:

K = probe cell constant (unitless)
C = measured conductance value of standard
T = temperature ($^{\circ}\text{C}$) of standard

Table 4 will be used to correct for the standard solution's conductivity value if it is not at 25°C .

Using the cell constant calculated above and the following formula, field specific conductance measurements will be corrected to 25°C .

$$S = \frac{K \cdot C}{(1 + 0.02 (T - 25))}$$

TABLE 4

CONDUCTIVITY TEMPERATURE CORRECTIONS
FOR 1,413 UMHOS/CM CONDUCTIVITY STANDARD

<u>Temperature, °C</u>	<u>umhos/cm</u>
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

Where:

S = specific conductance at 25°C
(umhos/cm)
K = calculated cell constant
C = field specific conductance
(umhos/cm)
T = temperature (°C) of sample at which
conductance was measured

- The Foxboro Century OVA 128 will be calibrated to a methane in air standard (87 ppm) once a week to ensure total volatile organic readings are accurate. The methane in air standard is manufactured by Liquid Carbonic and marked with its concentration. The standard is run directly into the intake of the pickup probe and the gain adjustment of the OVA 128 is then used to calibrate the reading to 87 ppm. Any OVA, total volatile organic readings will be reported as "X ppm as methane".
- The mercury vapor monitor will be calibrated daily in accordance with manufacturer's specifications using a mercury permeation membrane source supplied with the unit.

1.8 Analytical Procedures

All analytical procedures to be used for the Scott AFB sample analyses are officially approved EPA methods. The appropriate references are given in Attachment 1 and are also presented on Table 5. A complete list of the organic and inorganic compounds/constituents and the applicable analyte detection limits that will be required for all samples collected are presented in Table 5.

1.9 Data Reporting, Validation, and Reduction

Data validation practices will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which require reduction. All the field data, such as those generated during field measurements, observations and field instrument calibrations, will be entered directly into a bound field notebook. Each project team member will be responsible for proofing all data transfers made, and ERM's Quality Assurance Officer will proof at least ten percent of all data transfers.

Weston Analytics group leaders will check and validate all data generated by their group as specified in Attachment 1, Section 8.

TABLE 5

ANALYTICAL METHOD REFERENCES AND
METHOD DETECTION LIMITS (MDL)*

	Water		Solids**	
	Method ¹	MDL	Method ¹	MDL
Petroleum Hydrocarbons	418.12	1 mg/L	3550/418.12	50 mg/kg
Aromatic Volatile Organics	5030/8020		5030/8020	
benzene		0.7 ug/L		0.2 mg/kg
chlorobenzene		1 ug/L		0.2 mg/kg
1,2-dichlorobenzene		2 ug/L		0.2 mg/kg
1,3-dichlorobenzene		2 ug/L		0.2 mg/kg
1,4-dichlorobenzene		1 ug/L		0.2 mg/kg
ethyl benzene		1 ug/L		0.2 mg/kg
toluene		1 ug/L		0.2 mg/kg
xylenes		2 ug/L		0.2 mg/kg
Halogenated Volatile Organics	5030/8010		5030/8010	
bromodichloromethane		0.5 ug/L		0.1 mg/kg
bromoform		1 ug/L		0.1 mg/kg
bromomethane		6 ug/L		0.1 mg/kg
carbon tetrachloride		0.6 ug/L		0.1 mg/kg
chlorobenzene		1.2 ug/L		0.1 mg/kg
chloroethane		3 ug/L		0.1 mg/kg
2-chloroethyl vinyl ether		0.7 ug/L		0.1 mg/kg
chloroform		0.2 ug/L		0.1 mg/kg
chloromethane		0.7 ug/L		0.1 mg/kg
dibromochloromethane		0.5 ug/L		0.1 mg/kg
1,2-dichlorobenzene		0.5 ug/L		0.1 mg/kg
1,3-dichlorobenzene		1 ug/L		0.1 mg/kg
1,4-dichlorobenzene		1 ug/L		0.1 mg/kg
dichlorodifluoromethane		9 ug/L		0.1 mg/kg
1,1-dichloroethane		0.4 ug/L		0.1 mg/kg

TABLE 5
(Continued)

	<u>Water</u>		<u>Solids**</u>	
	<u>Method</u> ¹	<u>MDL</u>	<u>Method</u> ¹	<u>MDL</u>
1,2-dichloroethane		0.2 ug/L		0.1 mg/kg
1,1-dichloroethene		0.7 ug/L		0.1 mg/kg
trans-1,2-dichloroethene		0.5 ug/L		0.1 mg/kg
1,2-dichloropropane		0.2 ug/L		0.1 mg/kg
cis-1,3-dichloropropene		1 ug/L		0.1 mg/kg
trans-1,3-dichloropropene		2 ug/L		0.1 mg/kg
methylene chloride		2 ug/L		0.1 mg/kg
1,1,2,2-tetrachloroethane		0.2 ug/L		0.1 mg/kg
tetrachloroethene		0.2 ug/L		0.1 mg/kg
1,1,1-trichloroethane		0.2 ug/L		0.1 mg/kg
1,1,2-trichloroethane		0.1 ug/L		0.1 mg/kg
trichloroethene		0.6 ug/L		0.1 mg/kg
trichlorofluoromethane		5 ug/L		0.1 mg/kg
vinyl chloride		0.2 ug/L		0.1 mg/kg
Non-Halogenated Volatile Organics	5030/8015		5030/8015	
acrylamide		20 ug/L		1.0 mg/kg
carbon disulfide		20 ug/L		1.0 mg/kg
diethyl ether		20 ug/L		1.0 mg/kg
methyl ethyl ketone (MEK)		20 ug/L		1.0 mg/kg
methyl isobutyl ketone (MIBK)		20 ug/L		1.0 mg/kg
paraldehyde		20 ug/L		1.0 mg/kg
Extractable Priority Pollutants	3510/8270		3550/8270	
acenaphthene		10 ug/L		0.5 mg/kg
acenaphthylene		10 ug/L		0.5 mg/kg
anthracene		10 ug/L		0.5 mg/kg
benzo(a)anthracene		10 ug/L		0.5 mg/kg
benzo(b)fluoranthene		10 ug/L		0.5 mg/kg
benzo(k)fluoranthene		10 ug/L		0.5 mg/kg

TABLE 5
(Continued)

	<u>Water</u>		<u>Solids**</u>	
	<u>Method</u> ¹	<u>MDL</u>	<u>Method</u> ¹	<u>MDL</u>
benzo(a)pyrene	10	ug/L	0.5	mg/kg
benzo(ghi)perylene	10	ug/L	0.5	mg/kg
butyl benzyl phthalate	10	ug/L	0.5	mg/kg
4-bromophenyl phenyl ether	10	ug/L	0.5	mg/kg
bis(2-chloroethoxy)methane	10	ug/L	0.5	mg/kg
bis(2-chloroethyl)ether	10	ug/L	0.5	mg/kg
bis(2-chloroisopropyl)ether	10	ug/L	0.5	mg/kg
2-chloronaphthalene	10	ug/L	0.5	mg/kg
4-chlorophenyl phenyl ether	10	ug/L	0.5	mg/kg
chrysene	10	ug/L	0.5	mg/kg
dibenzo(a,h)anthracene	10	ug/L	0.5	mg/kg
di-n-butylphthalate	10	ug/L	0.5	mg/kg
1,2-dichlorobenzene	5	ug/L	0.5	mg/kg
1,3-dichlorobenzene	5	ug/L	0.5	mg/kg
1,4-dichlorobenzene	5	ug/L	0.5	mg/kg
3,3'-dichlorobenzidine	20	ug/L	0.5	mg/kg
diethyl phthalate	20	ug/L	0.5	mg/kg
dimethyl phthalate	10	ug/L	0.5	mg/kg
2,4-dinitrotoluene	10	ug/L	0.5	mg/kg
2,6-dinitrotoluene	10	ug/L	0.5	mg/kg
di-n-octyl phthalate	10	ug/L	0.5	mg/kg
bis(2-ethylhexyl)phthalate	10	ug/L	0.5	mg/kg
fluoranthene	10	ug/L	0.5	mg/kg
fluorene	10	ug/L	0.5	mg/kg
hexachlorobenzene	10	ug/L	0.5	mg/kg
hexachlorobutadiene	10	ug/L	0.5	mg/kg
hexachloroethane	10	ug/L	0.5	mg/kg
indeno(1,2,3-cd)pyrene	10	ug/L	0.5	mg/kg

TABLE 5
(Continued)

	Water		Solids**	
	Method ¹	MDL	Method ¹	MDL
isophorone		10 ug/L		0.5 mg/kg
naphthalene		10 ug/L		0.5 mg/kg
nitrobenzene		10 ug/L		0.5 mg/kg
N-nitrosodi-n-propylamine		10 ug/L		0.5 mg/kg
phenanthrene		10 ug/L		0.5 mg/kg
pyrene		10 ug/L		0.5 mg/kg
1,2,4-trichlorobenzene		10 ug/L		0.5 mg/kg
4-chloro-3-methylphenol		10 ug/L		0.5 mg/kg
2-chlorophenol		10 ug/L		0.5 mg/kg
2,4-dichlorophenol		10 ug/L		0.5 mg/kg
2,4-dimethylphenol		10 ug/L		0.5 mg/kg
2,4-dinitrophenol		50 ug/L		1.5 mg/kg
2-methyl-4,6-dinitrophenol		50 ug/L		1.5 mg/kg
2-nitrophenol		10 ug/L		0.5 mg/kg
4-nitrophenol		42 ug/L		0.5 mg/kg
pentachlorophenol		10 ug/L		0.5 mg/kg
phenol		10 ug/L		0.5 mg/kg
2,4,5-trichlorophenol		50 ug/L		1.5 mg/kg
2,4,6-trichlorophenol		10 ug/L		0.5 mg/kg
Organochlorine Pesticides/PCBs	3510/8080		3550/8080	
alpha-BHC		0.05 ug/L		.01 mg/kg
beta-BHC		0.05 ug/L		.01 mg/kg
delta-BHC		0.05 ug/L		.01 mg/kg
gamma-BHC (lindane)		0.05 ug/L		.01 mg/kg
heptachlor		0.04 ug/L		.01 mg/kg
aldrin		0.05 ug/L		.01 mg/kg
heptachlor epoxide		0.05 ug/L		.01 mg/kg
endosulfan I		0.05 ug/L		.01 mg/kg

TABLE 5
(Continued)

	<u>Water</u>		<u>Solids**</u>	
	<u>Method</u> ¹	<u>MDL</u>	<u>Method</u> ¹	<u>MDL</u>
dielddrin		0.08 ug/L		.02 mg/kg
4,4'-DDE		0.1 ug/L		.02 mg/kg
endrin		0.08 ug/L		.02 mg/kg
endosulfan II		0.1 ug/L		.02 mg/kg
4,4'-DDD		0.1 ug/L		.02 mg/kg
endosulfan sulfate		0.1 ug/L		.02 mg/kg
4,4'-DDT		0.1 ug/L		.02 mg/kg
methoxychlor		0.1 ug/L		0.1 mg/kg
endrin ketone		0.08 ug/L		.02 mg/kg
chlordane		0.5 ug/L		0.1 mg/kg
toxaphene		1 ug/L		0.2 mg/kg
Aroclor-1016		0.5 ug/L		0.1 mg/kg
Aroclor-1221		0.5 ug/L		0.1 mg/kg
Aroclor-1232		0.5 ug/L		0.1 mg/kg
Aroclor-1242		0.5 ug/L		0.1 mg/kg
Aroclor-1248		0.5 ug/L		0.1 mg/kg
Aroclor-1254		1 ug/L		0.2 mg/kg
Aroclor-1260		1 ug/L		0.2 mg/kg
Chlorinated Phenoxy Herbicides	8150		8150	
2,4-D		12 ug/L		0.8 mg/kg
2,4,5-T		2 ug/L		0.1 mg/kg
2,4,5-TP (Silvex)		2 ug/L		0.1 mg/kg
Metals Screen	3005/6010		3050/6010	
aluminum		0.2 mg/L		20 mg/kg
antimony		0.2 mg/L		20 mg/kg
barium		0.01 mg/L		2 mg/kg
beryllium		0.002 mg/L		0.2 mg/kg
boron		0.1 mg/L		20 mg/kg

TABLE 5
(Continued)

	Water		Solids**	
	Method ¹	MDL	Method ¹	MDL
cadmium		0.005 mg/L	2	mg/kg
calcium		0.1 mg/L	5	mg/kg
chromium		0.03 mg/L	4	mg/kg
cobalt		0.04 mg/L	4	mg/kg
copper		0.03 mg/L	3	mg/kg
iron		0.04 mg/L	4	mg/kg
magnesium		0.2 mg/L	20	mg/kg
manganese		0.01 mg/L	1	mg/kg
molybdenum		0.1 mg/L	20	mg/kg
nickel		0.015 mg/L	5	mg/kg
potassium		(determine at time of analysis)		
silica		0.3 mg/l	30	mg/kg
silver		0.03 mg/l	4	mg/kg
sodium		0.9 mg/l	90	mg/kg
thallium		0.2 mg/l	20	mg/kg
vanadium		0.04 mg/l	1	mg/kg
zinc		0.01 mg/l	1	mg/kg
arsenic	3005/7060	0.005 mg/L	3050/7060	0.5 mg/kg
lead	3005/7421	0.005 mg/L	3050/7420	20 mg/kg
mercury	3005/7470	0.001 mg/L	3050/7471	0.5 mg/kg
selenium	3005/7740	0.005 mg/L	3050/7740	1.0 mg/kg
Common Anions				
chloride	A429	0.5 mg/L		N/R
bromide	A429	0.5 mg/L		N/R
sulfate	A429	0.5 mg/L		N/R
phosphate	A429	0.5 mg/L		N/R
nitrate/nitrite	E353.1	0.1 mg/L		N/R
fluoride	E340.2	0.1 mg/L		N/R

TABLE 5
(Continued)

	<u>Water</u>		<u>Solids**</u>	
	<u>Method</u> ¹	<u>MDL</u>	<u>Method</u> ¹	<u>MDL</u>
Alkalinity	A403	10.0 mg/L		N/R
Cyanide	9010	0.2 mg/L	9010	20 mg/kg

Notes:

1. Unless otherwise specified, analytical methods are from: Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition (USEPA, 1986).
 2. Methods for Chemical Analysis of Water and Wastewater, EPA Manual, 600/4-79-020 (USEPA, 1983 with additions).
 3. Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA Manual 600/4-80-032 (USEPA, August 1980 update)
 4. U.S. Department of Energy, HASL-300
 5. Soil Moisture Content results will be calculated using a corrected calculation method (differs from ASTM reference method). These results will be used to calculate soil analytical results on a dry weight basis from wet weight results.
- * Specific detection limits are highly matrix dependent. The detection limits listed are provided for guidance and may not always be achievable.
- ** Detection limits listed for soil/sediment are based on wet weight. The detection limits for soil/sediments calculated by the laboratory on a dry weight basis as required, will be higher.

Upon receipt of the sample data packages, the laboratory data will again be quantitatively and qualitatively validated by ERM's Quality Assurance Manager. Data validation is discussed in detail in Section 1.13.

It is anticipated that ERM's data reduction for this investigation will be minimal and will consist primarily of tabulating analytical results from Weston Analytics' Form I (Analytical Reports) onto summary tables through the use of computerized spreadsheet software. All reduced data will be assigned document control identification numbers and placed in the central file maintained by the Project Manager.

All analytical data obtained during the course of the investigation for ground waters and surface waters will be reported as ug/l. Laboratory data for soil analyses will be reported as mg/kg (organics) on a dry weight basis. Data packages associated with the analyses of samples collected during the investigation will be prepared utilizing data package deliverables listed in Section 1.4.3.

1.10 Internal Quality Control Checks

Internal quality control checks for both laboratory and field are summarized below and in Table 6.

1.10.1 Laboratory Internal Quality Control Checks

Weston Analytics' Internal Quality Control Checks are presented in Attachment 1, Section 9. These will be a continuation of ERM's Field Internal Quality Control Checks presented below.

1.10.2 Field Internal Quality Control Checks

Field Internal Quality Control Checks will be utilized during this investigation through the use of the following:

- Trip Blanks - These blanks consist of ultrapure, deionized water contained in each sample container with any preservatives required for that analysis. ERM produces ultrapure deionized water by use of a Hydro® Model 28C2-44PE Ultrapure Water System. This water satisfies the requirements for ASTM Type II reagent water. These blanks will accompany the samplers during the sampling process and will serve as QC check on container cleanliness and the analytical method. One trip blank will be taken (both soils and waters) with every batch of VOC samples and sent to the laboratory.

TABLE 6

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 6010 (ICP)	Trace Metals	Lab	SO,WA	Calibration Control sample	Daily, to validate calibration standard	Measured value within $\pm 10\%$ of true value for all elements	1) Prepare new calibration standard 2) Repeat calibration 3) If still out, qualify results for affected elements
			SO,WA	Laboratory duplicate sample	5%; minimum of 1 per batch of 20 or fewer samples (for each matrix)	Analyses agreement within 20% relative percent difference (RPD) for species of interest	Will be used to determine sample variability
			SO,WA	Instrument continuing calibration check standard	10%; minimum of 1 per set	Measured value within $\pm 10\%$ true value for elements of interest	1) Repeat calibration and check standard analysis 2) Repeat analysis of affected set(s) after check standard passes
			SO,WA	Method blank analysis	Daily prior to sample analyses	Below method detection limits	Will be used to indicate analytical contaminants
			SO,WA	Interference check standard	once at beginning, once at end of analysis day; min. every 8 hours	Measured values within $\pm 20\%$ the true values	1) Terminate analyses 2) Correct problem 3) Recalibrate 4) Reanalyze samples
			SO,WA	Spiked sample analyses	5%; minimum of 1 per batch of 20 or fewer samples	Spike recovery between 75-125% of additions	Will be used to determine sample matrix effects.
			SO,WA	Lab control Standard (LCS)	2 per batch of 20 or fewer samples	Recovery between 80-120%, except Ag, Sb	1) Evaluate usability of data 2) Redigest and reanalyze batch if necessary
		Field	SO,WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine source of sample equipment contamination (see text)
			WA	Field replicate samples	10%; minimum of 1 per program	Analyses agreement within 25% relative percent difference (RPD)	Will be used to determine sampling analytical variability, representativeness (see text)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 6010 (Cont)			SO,WA	Travel blank	1 per sample shipment	Dependent upon sample contaminant levels	Will be used to assess sources of contamination for sample, container, preservatives, shipping and storage processes
EPA 7060 As EPA 7421 Pb EPA 7471 Se EPA 7740 Hg Atomic Absorption (AA)		Lab	SO,WA	Calibration Control sample	10%; minimum 1 in duplicate with each sample set	1) Recovery between 90-110% 2) Replicate analysis CV ≤5%	1) Repeat control sample analysis 2) If still out quality results for affected elements
			SO,WA	Method blank analysis	One blank per sample set	Below method detection limits	1) Will be used to indicate analytical contaminants
			SO,WA	Laboratory duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) ≤20%	Will be used to determine sample variability.
			SO,WA	Spiked sample analyses	5%; minimum of 1 per set	Spike recovery between 75-125%	Will be used to determine sample variability.
			SO,WA	Lab control Standard (LCS)	2 per batch of 20 or fewer samples	Recovery between 80-120%, except Ag, Sb	1) Evaluate usability of data 2) Redigest and reanalyze batch if necessary
		Field	SO,WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine sources of sample equipment contamination (see text)
			WA	Field replicate	10%; minimum of 1 per program	Analyses agreement without 25% relative percent difference	Will be used to determine sampling/ analytical variability (see text)
			SO,WA	Travel blank	1 per sample shipment	Dependent upon sample contaminant levels (assessment by consultant)	Will be used to assess sources of contamination from sample containers, shipping and storage processes
EPA 8270-GC/MS	Semi-volatile extractable organics	Lab	SO,WA	Mass scale calibration using PFTBA	Daily prior to sample analyses	Refer to method	1) Adjust mass assignments 2) Repeat calibration

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 8270 (Cont)			SO,WA	Calibration verification	Every 12 hours	1) CCC response within $\pm 25\%$ of initial calibration 2) SPCC to internal standard RF ratio ≥ 0.050	1) Repeat check standard 2) If still out troubleshoot instrument for possible problem (i.e., column, injector port, etc.) 3) Perform a new multi-point calibration curve
			SO,WA	Surrogate standard spike	All samples	Refer to Method	1) If two or more surrogates (per fraction) are outside criteria the sample must be reextracted and reanalyzed for that fraction 2) If still out, flag results as outside data control limits
			SO,WA	Method blank analysis	Daily	Below the method detection limits. (5 times the MDL allowed for phthalate esters)	1) Will be used to indicate analytical contaminants. 2) If the contaminant occurred at the extraction step, data with positive results for that analyte should be flagged (B).
			SO,WA	Matrix spike duplicate analyses	5%; minimum of 1 per set	Refer to method	1) Flag results as outside data control limits
			SO,WA	Internal standards	All samples	If any internal standard area changes by a factor of 2 (-50% to +100%) from the last daily calibration check	1) Inspect system for problem 2) Reanalyze affected samples
			SO,WA	Check of mass spectral ion intensities using DFTPP	Daily prior to sample analyses	Refer to method	1) Retune instrument 2) Repeat DFTPP analysis 3) Do not analyze samples until an acceptable tune is achieved
	Field		SO,WA	Equipment blanks	10%; minimum of 1 per program	Dependent on contaminant levels	Will be used to determine sources of sampling equipment contamination (see text)
			SO,WA	Trip blank	1 per sample shipment	Dependent upon contaminant levels	Will be used to assess contamination from sample containers, shipping and storage
			WA	Field Replicates	10%; minimum of 1 per program	Analyses agree within 30% RPD	Will be used to determine sampling/analytical variability

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 418.1	Total petroleum hydrocarbons	Field	SO,WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine sources of sampling equipment contamination
			WA	Field Replicates	10%; minimum of 1 per program	Analysis agreement within 25% relative percent difference (assessment by consultant)	Will be used to determine sampling/ analytical variability
		Lab	SO,WA	Duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 20\%$ water, $\leq 30\%$ soil	Will be used to determine sample variability
			SO,WA	Spiked sample analyses	5%; minimum of 1 per set	Spike recovery between 75-125%	Will be used to determine sample matrix effects.
			SO,WA	Method blank analysis	Daily prior to sample analyses	Below method detection limits	Will be used to indicate analytical contaminants
			SO,WA	Calibration Control sample	Weekly, to validate calibration standard	Measured value within $\pm 5\%$ of true value	1) Prepare new calibration standard 2) Repeat calibration before any samples are analyzed
ASTM D2216	Soil moisture content	Field	WA	Field replicate	10%; minimum of 1 per program	Agreement within 5% (assessment by consultant)	Will be used to determine sampling/ analytical variability
			SO,WA	Duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 20\%$	Will be used to determine sample variability
		Lab	SO,WA	Method blank analysis	Daily prior to sample analyses	Below detection limit	1) Clean glassware 2) Repeat sample and blank analysis
EPA 8080 GC	Organochlorine Pesticides and PCBs	Lab	SO,WA	Control sample	5%; minimum of 1 per set	Agreement with control sample theoretical concentration $\pm 20\%$	Restandardize; repeat control sample analysis

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 8080 GC (continued)		Lab	SO,WA	Surrogate standard spike	All samples	Refer to method 8000 and current laboratory control charts	1) Surrogate recoveries are advisory 2) High concentration of analytes justifying dilution, resulting in loss of surrogate, is exempt from reextraction
			SO,WA	Matrix spike	5%; minimum of 1 per set	Refer to method 8000 and current laboratory control charts	Will be used to determine sample matrix effects.
			SO,WA	Hexane rinse	After sample with high result	Below method detection limit	1) Clean system 2) Analyze clean hexane again
			SO,WA	Duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 30\%$ for 90% of the quantitated peaks (all peaks in excess of 10% of the internal standard)	Will be used to determine sample variability
			SO,WA	DDT and endrin breakdown	1 per set, prior to analysis	<20% breakdown	1) Check and correct system (i.e., column, injector) 2) Reanalyze standard for breakdown
			SO,WA	Method blank analyses	Daily	Refer to method	1) Will be used to indicate analytical contaminants 2) If contamination was in the extraction flag all positive results for that analyte with a "B"
		Field	WA	Replicate samples	10%; minimum of 1 per program	Agreement within 25% relative percent difference (consultant assessment)	Will be used to determine sampling/analytical variability
			SO,WA	Equipment blanks	10%; minimum of 1 per program	Below the method detection limit	Will be used to determine sources of equipment contamination (see text)

TABLE 6 (Continued)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL APPLICABLE QUALITY CONTROL MATRIX					FREQUENCY (a)		ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
METHOD	PARAMETER	CHECK LOCATION	SO, OR WA	CHECK TYPE				
8010 GC	Purgeable halocarbons	Lab	SO,WA	Linearity check (at multipoint calibration) using standard containing species of interest	Initially, prior to sample analyses	percent relative standard deviation is less than 20%	Repeat linearity check	
			SO,WA	Calib. check sample	Once prior to sample analyses	Current lab control charts	Calibration	
			SO,WA	Spiked sample analysis	5%; minimum of 1 per set	Current lab control charts	Will be used to indicate sample matrix effect	
			SO,WA	Surrogate spike	All samples	Current lab control charts	1) Reanalyze sample 2) If still out quality results	
			SO,WA	Method blank analyses	Daily prior to sample analyses	Below method detection limit	Will be used to indicate analytical contaminants	
			SO,WA	Control sample analysis	1) Following calibration 2) 5%; minimum of 1 per set	Current lab control charts	Repeat control sample analysis	
			SO,WA	Laboratory duplicate analyses	5%; minimum of 2 per set	Relative percent difference (RPD) ≤25% water	Will be used to indicate sample variability	
			SO,WA	Equipment blanks	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
			SO,WA	Trip blanks	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
			WA	Ambient condition blank	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
EPA 8020 GC/PID	Purgeable aromatics	Lab	WA	Field Replicate	5%; minimum of 1 per set	Within 25% relative percent difference	Will be used to determine sampling/analytical variability	
			SO,WA	Linearity check (at multipoint calibration) using standard containing species of interest	Initially, prior to sample analyses	Percent relative standard deviation is less than 20%	Repeat linearity check	
			SO,WA	Acceptability tests	Once prior to sample analyses	Refer to method, Section 8.6 (EPA 8000)	Repeat acceptability test	
			SO,WA					

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TABLE 6 (Continued)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE MATRIX	CHECK LOCATION	SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION	
							(for out-of-control events)	
EPA 8020 (Cont)	Lab	SO,WA		Spiked sample analysis	5%; minimum of 1 per set	Current lab control charts	Will be used to indicate sample effects matrix	
				Surrogate spike	All samples	Current lab control charts	1) Reanalyze sample 2) If out quality results	
				Method blank analyses	Daily	Below the method detection limit	1) Clean system 2) Repeat blank analysis	
				Control sample analysis	1) Following calibration 2) 5%; minimum of 2 per set	Current lab control charts	1) Repeat control sample analysis 2) Repeat calibration	
				Laboratory duplicate analyses	5%; minimum of 2 per set	Relative percent difference (RPD) $\leq 25\%$	1) Will be used to indicate sample variability 2) If out quality results	
	Field	SO,WA		Equipment blanks	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
				Trip blanks	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
				Ambient condition blank	5%; minimum of 1 per set	Below the method detection limit (consultant will assess)	Will be used to determine sources of contamination	
				Field replicate	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 25\%$	Will be used to determine sampling/analytical variability	

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
EPA 9010	Cyanide	Lab	SO,WA	Calibration Standards	Daily, to calibrate spectrophotometer	Correlation coefficient not <0.996	Repeat calibration
			SO,WA	Laboratory duplicate sample	5%; minimum of 1 per batch of 20 or fewer samples (for each matrix)	Analyses agreement within 20% relative percent difference (RPD) for species of interest	Will be used to determine sample variability
			SO,WA	Method blank analysis	Daily prior to sample analyses	Below method detection limits	Will be used to indicate analytical contaminants
			SO,WA	Spiked sample analyses	5%; minimum of 1 per batch of 20 or fewer samples	Spike recovery between 75-125% of additions	Will be used to determine sample matrix effects.
			SO,WA	Lab control Standard (LCS)	2 per batch of 20 or fewer samples	Recovery between 80-120%	1) Evaluate usability of data 2) Reanalyze batch if necessary
		Field	SO,WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine source of sample equipment contamination (see text)
			WA	Field replicate samples	10%; minimum of 1 per program	Analyses agreement within 25% relative percent difference (RPD)	Will be used to determine sampling analytical variability, representativeness (see text)
			SO,WA	Travel blank	1 per sample shipment	Dependent upon sample contaminant levels	Will be used to assess sources of contamination for sample container, preservatives, shipping and storage processes

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
A 429 IC	Common Anions (Chloride, Bromide, Sulfate, Phosphate)	Lab	WA	Calibration Standards	Daily, to calibrate instruments	Correlation coefficient not <0.996	Repeat calibration
EPA 340.1	Fluoride		WA	Laboratory duplicate sample	5%; minimum of 1 per batch of 20 or fewer samples, (for each matrix)	Analyses agreement within 20% relative percent difference (RPD) for species of interest	Will be used to determine sample variability
EPA 353.1	Nitrate/Nitrite		WA	Instrument continuing calibration check standard	10%; minimum of 1 per set	Measured value within $\pm 20\%$ true value for anions of interest	1) Repeat calibration and check standard analysis 2) Repeat analysis of affected set(s) after check standard passes
			WA	Method blank analysis	Daily prior to sample analyses	Below method detection limits	Will be used to indicate analytical contaminants
			WA	Spiked sample analyses	5%; minimum of 1 per batch of 20 or fewer samples	Spike recovery between 75-125% of additions	Will be used to determine sample matrix effects.
			WA	Lab control Standard (LCS)	2 per batch of 20 or fewer samples	Recovery between 80-120%	1) Evaluate usability of data 2) Reanalyze batch if necessary
		Field	WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine source of sample equipment contamination (see text)
			WA	Field replicate samples	10%; minimum of 1 per program	Analyses agreement within 25% relative percent difference (RPD)	Will be used to determine sampling analytical variability, representativeness (see text)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
A 509B GC	Chlorinated Phenoxy Herbicides	Lab	SO,WA	Calibration check standard	once per shift	Agreement with calibration $\pm 20\%$	Recalibrate; repeat standard analysis
			SO,WA	Matrix spike	5%; minimum of 1 per set	Refer to method 8000 and current laboratory control charts	Will be used to determine sample matrix effects.
			SO,WA	Solvent rinse	After sample with high result	Below method detection limit	1) Clean system 2) Analyze clean solvent again
			SO,WA	Duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 30\%$	Will be used to determine sample variability
			SO,WA	Method blank analyses	Daily, with each batch	Refer to method	1) Will be used to indicate analytical contaminants 2) If contamination was in the extraction flag all positive results for that analyte with a "B"
			SO,WA	Method blank spike analysis	minimum of 1 per batch	Refer to laboratory control charts	1) Evaluate usability of data 2) Reanalyse batch, if necessary
		Field	SO,WA	Replicate samples	10%; minimum of 1 per program	Agreement within 25% relative percent difference (consultant assessment)	Will be used to determine sampling/ analytical variability
			SO,WA	Equipment blanks	10%; minimum of 1 per program	Below the method detection limit	Will be used to determine sources of equipment contamination (see text)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES

ANALYTICAL METHOD	APPLICABLE PARAMETER	QUALITY CONTROL CHECK LOCATION	MATRIX SO, OR WA	CHECK TYPE	FREQUENCY (a)	ACCEPTABLE CRITERIA	CORRECTIVE ACTION (for out-of-control events)
A 403	Alkalinity (Field test)	Field	WA	Equipment blanks	10%; minimum of 1 per program	Dependent upon sample contaminant levels	Will be used to determine sources of sampling equipment contamination
			WA	Field Replicates	10%; minimum of 1 per program	Analysis agreement within 25% relative percent difference (assessment by consultant)	Will be used to determine sampling/analytical variability
			WA	Duplicate analyses	5%; minimum of 1 per set	Relative percent difference (RPD) $\leq 20\%$ water	Will be used to determine sample variability
			WA	Method blank analysis	Daily prior to sample analyses	Below method detection limits	Will be used to indicate analytical contaminants
			WA	Calibration Control sample	Minimum of 2 per program	Measured value within $\pm 10\%$ of true value	1) Prepare new calibration standard 2) Repeat calibration before any samples are analyzed

- Ambient Condition Blanks - These blanks will consist of ASTM Type II water as described above. These blanks will be poured into the appropriate glassware at the site, then will be handled like a sample and transported to the laboratory for analysis. One ambient condition blank will be submitted per VOC sampling at a particular site or zone to monitor for potential contamination present on-site at the time of sample collection.
- Equipment Blanks - These blanks will consist of ASTM Type II water and will be collected for everyday of ground water for all analytical parameters. This type of blank is collected by placing Type II water into the sampling device (or pump), transferred to an appropriate sample bottle, and then transported to the laboratory for analysis. Equipment blanks monitor the introduction of contamination due to residual contamination present after equipment decontamination.
- Field Duplicates - One in every ten water samples will be collected as a field duplicate and analyzed for all parameters. A field duplicate is prepared by collecting two samples independently at the same sample location during a single act of sampling. Field duplicates shall be submitted "blind" or shall be indistinguishable from other samples so that laboratory analysts will not be able to determine which samples are duplicates. Relative percent difference between field replicate results will be used to assess representativeness.
- Field Replicates - One in every ten soil/sediment samples will be collected as a field replicate. A field replicate is collected by collecting a single sample and then dividing it into two equal aliquots. Field replicates will also be submitted "blind" and will be used to assess analytical precision.
- Matrix Spike/Matrix Spike Duplicate Samples (MS/MSD) - A matrix spike and matrix spike duplicate will also be submitted as a further QC check. These will be collected after every 20 aqueous samples, and after every 20 soil or sediment samples. Three times the normal volume required will be collected at locations selected for MS/MSD samples. These will be submitted as separate aliquots with the appropriate sample identification and the designation "to be matrix spiked". These will allow accuracy to be determined by the recovery rates of compounds (the matrix spike and/or surrogate spike compounds defined in the analytical methods). The purpose of these laboratory spikes is to monitor any possible matrix effects specific to samples collected from the subject site. The addition of known

concentrations of compounds/constituents into the sample also monitors extraction/digestion efficiency. Matrix spike duplicates monitor analytical precision by direct comparison of recoveries.

The specific sample location which will be used for matrix spikes, duplicates, and replicates will be chosen by the Quality Assurance Officer.

1.11 Performance and System Audits

1.11.1 On-Site Audit

An on-site system audit will be performed during major field activities to review all field-related quality assurance activities. The system audit will be conducted by ERM's Quality Assurance Officer. Figure 9 presents ERM's Quality Assurance Audit forms.

Specific elements of the on-site audit include the verification of:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions, and signatures.
- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person collecting sample, preservation method used, and type of testing required.
- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person collecting samples, types of samples, results of field measurements, soil logs, and any problems encountered during sampling.
- Adherence to health and safety guidelines outlined in the Site Health and Safety Plan including wearing of proper protective clothing.
- Adherence to decontamination procedures outlined in Section 2.4.6 of this QAPP, including proper decontamination of pumps and pump tubing, bailers, and sampling equipment.
- Adherence to sample collection, preparation, preservation, and storage procedures.

FIGURE 9
ERM QUALITY ASSURANCE AUDIT

PROJECT _____ W.O.# _____

DATE _____ AUDIT CONDUCTED FROM ____ HR. TO ____ HR.

AUDITOR(S): _____

ON-SITE SAMPLING PERSONNEL: _____

Audit Conducted on the Following:

_____ Soil Sampling	_____ Decontamination
_____ Surface Water/Sediment	_____ Health & Safety
_____ Ground Water	

Sample Collection:

Do sampling locations agree with those specified
in the Work Plan? _____

Is the sampling locating either documented
sufficiently or marked to allow it to be
found/sampled again in the future? _____

Are sampling times, ERM Traffic Report Numbers and
sample description noted? _____

Is sampling proceeding from the suspected least
contaminated area to the most contaminated area? _____

Have sample bottles been labeled properly? _____

Have proper containers and preservatives been used? _____

Are proper sample volumes procured? _____

Are samples being refrigerated/iced immediately
after collection? _____

Does a travel blank exist for each matrix present? _____

Does the potential for sample cross-contamination
exist based on procedures observed? _____

FIGURE 9 - Continued

Soil Sampling (Check if not applicable _____):

Type: _____ Hand _____ Auger or Rig _____

Are samples being collected at proper depths? _____

Are samples being screened with an OVA (if specified in Work Plan and applicable)? _____

Is a description of soils/materials being logged? _____

(Have soils been homogenized where applicable (specified by the Sampling Plan)? _____

Surface Water/Sediment Sampling (Check if not applicable _____):

Have stream flow and velocity parameters been noted? _____
Estimated _____ or Measured _____

Has sampling proceeded from downstream to upstream locations? _____

Has the sampler acquired the water sample upstream of his position to minimize suspended sediment from entering the sample? _____

Have water samples been collected in the mixing zone, not stagnant areas? _____

Have sediments been characterized as to type and size distribution? _____

Has the proper sediment fraction (fine, depth) been sampled for the analyses of interest? _____

Are the selected locations effectively monitoring effects of the potential source? _____

Ground Water Sampling (Check if not applicable _____):

Have the well specifications been noted properly (i.e., Total Depth, Casing diameter, Depth-to-water to the nearest one-hundredth of a foot, etc.)? _____

Has the purge volume been calculated properly? _____

What evacuation method has been used?

_____ Bailer _____ Submersible _____ Bladder Pump
_____ Other (_____)

If metals are being analyzed, have the samples been field filtered? _____

Are field pH, conductivity, and temperature being measured? _____ Is there documentation of calibrating the instruments? _____

FIGURE 9 - Continued

Has well yield been properly evaluated to determine when sample acquisition should take place (i.e., well goes dry and needs to recover). _____

Is bailer line and bailer dedicated to each well and line disposed of after use? _____

Bailer type _____ Line type _____

Have appropriate measures been taken to dispose of contaminated purge water, pump lines, bailers, etc? _____

For Domestic Wells - Has as much information on the well and distribution system been obtained, i.e., depth, casing type, diameter, treatment present, etc.? _____

Has the sample been collected prior to treatment and as close to the well head as possible? _____

Has the domestic well been purged sufficiently to reach temperature stabilization? _____

Have the weather conditions been recorded? _____

Decontamination:

Has sampling equipment been decontaminated properly for the given analytes? _____

Have the proper decontamination solutions been used? _____

For large equipment (backhoes, drill rigs), has decontamination taken place in an appropriate area? _____

Has decontaminated water/solution been collected for proper disposal? _____ Where disposed? _____

Safety:

Is the proper level of protective clothing being worn for the tasks? _____ Level A ____ B ____ C ____ D ____

Is the site Health and Safety Plan present with proper emergency contacts included? _____

Is monitoring equipment present? _____ OVA _____
H₂, O₂ meter _____ Explosimeter _____ Other _____

Is the vehicle equipped with a First Aid Kit? _____

Is contaminated protective clothing being disposed of properly? _____

Are personnel aware of the contaminants present at the site? _____

General:

Are weather conditions affecting sample quality?

Audit Summary and Comments:

[illegible]

Print:

Date: _____

On-site audits may also be performed by appropriate USEPA personnel from the Central Project Management Section of the Central Regional Lab.

1.11.2 Laboratory Audit

1.11.2.1 Internal Laboratory Audit

Weston Analytics performs regular systems and performance audits, and these are described in attachment 1, Section 10.

1.12 Laboratory and Field Maintenance

1.12.1 Laboratory Maintenance

A typical standard operating procedure for maintenance, including specific routine and preventive procedures, and maintenance logs for the gas chromatograph/mass spectrometer is given in Attachment 1, Section 11.0.

1.12.2 Field Maintenance

ERM's field equipment is maintained through the use of a tracking system incorporating the tagging of each equipment item. This tag identifies its most recent maintenance, battery charge, and condition. When damaged or equipment in need of repair is returned to the equipment warehouse, it is appropriately flagged for the required maintenance to be performed. This process assures only operable and maintained equipment enters the field. Routine daily maintenance procedures conducted in the field will include:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment and measurement systems.
- Cleansing of filters in the organic vapor analyzer.
- Storage of equipment away from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (e.g., cracked or clogged lines or tubing or weak batteries).
- Check instrument calibrations as described in Section 1.7.2 of the QAPP.
- Charging any battery packs for equipment when not in use.

Spare and replacement parts stored in the field to minimize downtime include:

- Appropriately sized batteries
- Locks
- Extra sample containers and preservatives
- Bailer line
- Additional bailers
- OVA igniters and filters
- OVA H₂ gas; battery charger, and support equipment
- Spare filters for filtration apparatus.
- Extra pH probes, conductivity probes, sample coolers, packing material, and sample location stakes.
- Additional supply of health and safety equipment, i.e., respirator cartridges, boots, gloves, tyvek suits, etc.
- Additional equipment as necessary for the field tasks.

1.13 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

1.13.1 Overall Project Assessment

Overall data quality will be assessed by a thorough understanding of the data quality objectives which are stated during the design phase of the investigation. By maintaining thorough documentation of all decisions made during each phase of sampling, performing field and laboratory audits, thoroughly reviewing (validating) the analytical data as it is generated by the laboratory, and providing appropriate feedback as problems arise in the field or at the laboratory, ERM will closely monitor data accuracy, precision and completeness. Examples of how these will be assessed were shown in Table 2.

1.13.2 Field Data Quality Assessment

To assure that all field data are collected accurately and correctly, specific written instructions will be issued to all personnel involved in field data acquisition by the Project Manager. The Quality Assurance Officer will perform field audit(s) during the investigation to document that the appropriate procedures are being followed with respect to sample

(and blank) collection. These audits will include a thorough review of the field books used by the Project personnel to insure that all tasks were performed as specified in the instructions. The field audits will necessarily enable the data quality to be assessed with regard to the field operations.

The evaluation (data review) of the various types of blanks, and other field QC samples will provide definitive indications of the data quality. If a problem that can be isolated arises, corrective actions can be instituted for future field efforts.

1.13.3 Laboratory Data Quality Assessment

Specific measures that will be taken by Weston Analytics to assess data quality are presented in Attachment 1, Section 12.

1.13.4 ERM's Laboratory Data Assessment

1.13.4.1 ERM Data Validation

All analytical data generated during the investigation will undergo a rigorous ERM data review. This review will be performed in accordance with the "Functional Guidelines for the Evaluation of Organic (and Inorganic) Analysis".

A preliminary review will be performed to verify that all necessary paperwork (chain-of-custodies, traffic reports, analytical reports, laboratory personnel signatures) and data package deliverables are present.

A detailed quality assurance review will be performed by the ERM Quality Assurance Manager (or a staff reviewer) to verify the qualitative and quantitative reliability of the data as it is presented. This review will include a detailed review and interpretation of all data generated by Weston Analytics. The primary tools used by experienced data review chemists include: guidance documents, established (contractual) criteria, and professional judgment. Table 7 presents the items examined during the quality assurance review.

Based upon the review of the analytical data, a quality assurance report will be prepared which will state in a technical yet "user friendly" fashion the qualitative and quantitative reliability of the analytical data. The report will consist of a general introduction section, followed by qualifying statements that should be taken into consideration for the analytical results to best be utilized. Based upon the quality assurance review, qualifier codes will be placed next to specific sample results on the sample data table. These qualifier codes will serve as an indication of the qualitative and quantitative reliability.

TABLE 7

ITEMS REVIEWED DURING THE ERM DATA VALIDATION
FOR A WESTON LEVEL II DATA PACKAGE

<u>Areas Examined</u>	<u>Applicability</u> (organic, inorganic, both)
ERM and Laboratory Chain of Custodies (Traffic Reports, Field Notes, Etc)	Both
Laboratory Narrative and QC Summaries	
Holding Times	Both
Extraction/Digestion Logs	Both
Blanks - field and laboratory (accuracy)	Both
Instrument Tune	Organic
Samples	
Detection Limits	Both
Instrument Printouts	Both
ICP data	Inorganic
AA data	Inorganic
GC data	Organic
GC/MS data	Organic
Autoanalyzer data	Inorganic
Qualitative Identification	Both
Mass spectra	
Tentatively identified compounds	
Quantitative Reliability	Both
Calculations/Equations	Both
Matrix spikes (accuracy)	Both
Bias	
Matrix spike duplicates	Organic
Bias	
Accuracy & Precision	
Surrogate Spikes	Organic
Bias	
Duplicates (field and laboratory)	Both
Precision	
Representativeness	

During the course of the data review, an organic and inorganic support documentation package is prepared which will provide the backup information that will accompany all qualifying statements presented in the quality assurance review.

Once the review has been completed, the Quality Assurance Manager will then submit these data to the Project Manager. The approved data tables and quality assurance reviews will be signed and dated by the Quality Assurance Manager.

1.13.5 Management Data Quality Assessment

As the analytical data generated from the subject investigation are validated, qualified and submitted to the Project Manager, the quality of the data will be assessed from an overall management perspective by direct comparison of analytical results obtained within the same general vicinity. This can aid in the identification of missing data points. By examination of the data at the "back-end" of the process, the data quality can be assessed with respect to representativeness, precision, compatibility and completeness.

1.14 Corrective Action

1.14.1 Laboratory's Corrective Action

Correction actions for Weston Analytics are presented in Attachment I, Section 12. Weston Analytics will provide documentation as to what, if any, corrective actions were initiated concerning this study and report them to ERM's Quality Assurance Manager.

1.14.2 ERM's Corrective Action

Field quality assurance activities will be reported topically to ERM's Project Manager. Problems encountered during the study affecting quality assurance will be reported on a Corrective Action Form as presented in Figure 10. The Project Manager will be responsible for initiating the corrective actions and for insuring that the actions are taken in a timely manner, and that the desired results are produced. The Project Manager will report to the Quality Assurance Manager and Quality Assurance Officer on all necessary corrective actions taken, the outcome of these actions, and their affect on data produced. All corrective action taken will be reported to the Air Force.

1.15 Quality Assurance Reports to Management

On a bi-monthly basis after project initiation the Project Manager, in conjunction with the Quality Assurance Manager and

Corrective Action Form

Problem Description: _____

Corrective Action: _____

cc: Project Manager - _____
QA Manager - _____
QA Officer - _____

Officer, will submit in the RI progress report summaries of all applicable quality assurance activities. These summaries shall contain at least the following types of information:

- The status and coverage of various laboratory and field quality assurance project activities.
- Data quality assurance reviews including assessment of: accuracy, precision, completeness, representativeness, and comparability.
- Significant quality assurance problems discovered, corrective actions taken, progress and improvements, plans, and recommendations for further implementation or updating of the investigative QAPP.
- Any significant field observations noted in the field notebook during the sampling procedure.
- A summarization of the results of performance and system audits.